

Recovery of Weathered Crude Oil from Sand ex Kuwait Using Seawater

Objective

Trial was to demonstrate cost effective separation and recovery of weathered crude oil from sand that was heavily contaminated with oil spills eighteen years ago. It successfully used small quantities (1% to 2% by

weight of material to be treated) of surfactant blends with cold salt water to achieve separation of the crude oil from the sand.

Overview

A number of tests were carried out to determine the most effective combination of chemicals/surfactants and minimum effective concentrations to achieve the best result.

The starting point to recover the crude oil from the sand was a surfactant system developed by Global Advantech to wash oil well drill cuttings heavily contaminated with crude oil hydrocarbons (ex BP Wytch Farm, UK) – see *Case Study CS060*. This uses suitably designed mechanical washing plant with very high shear mixing to combine the drill cuttings with a solution of the surfactant system (OBM Drill Cuttings Washing Agent DC511) in fresh or salt water. The hydrocarbons separate from the drill cuttings into the surfactant wash solution without a stable emulsion being formed; the hydrocarbons coalesce into drops which float to the surface enabling them to be recovered in an oil water separator.

A method to separate the weathered crude oil from the sand ex Kuwait was developed, which uses two surfactant formulations with differing properties that interact during washing to rapidly release the crude oil from the sand grains. The two formulations used are:

1. **Hydrocarbon Soil and Sludge Oil–Phase Washing Agent DC211** is a formulation of oil-soluble surfactants and other compounds, with a solvent carrier to facilitate rapid penetration into and mixing with weathered crude oil mass. This formulation is mixed into the weathered crude oil/sand mixture at a rate of between 1% and 2% by weight causing it to liquefy.
2. **Hydrocarbon Soil and Sludge Aqueous–Phase Washing Agent DC221** is a salt water-soluble surfactant formulation. This is mixed with sea water to make up a process solution that contains 0.25% and 0.5% of the formulation by weight. The process solution is used to wash and separate the crude oil after it has been mixed with DC211. During washing, surfactants in the aqueous-phase DC221 interact across oil-water boundaries with surfactants in the oil-phase DC211 dissolved in crude oil facilitating its removal from the sand into the process solution, without forming a stable emulsion. The released crude oil rapidly coalesces and floats to the surface of the process solution, where it can be collected.

Demonstration

The following section describes the method used to wash the crude oil out from the sand and the results obtained.

Approximately 300g of the weathered crude oil contaminated sand ex Kuwait containing approximately

20% of crude oil by weight, was available for the development and tests.)

Global Advantech Limited

Exceptional clean technologies for a sustainable future.....

Energy House, 14 Maurice Close, Kimbolton, Cambridgeshire, PE28 0HD, United Kingdom
 † +44 (0)845 519 0159 / † enquiries@globaladvantech.com / www.globaladvantech.com

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Method

 <p>1. A sample of weathered crude oil contaminated sand ex Kuwait was selected.</p>	 <p>2. 1.25% by weight of Hydrocarbon Soil and Sludge Oil-Phase Washing Agent DC211 was added to the sample of weathered crude oil and sand and mixed for approximately 30 seconds liquefying the crude oil.</p>	 <p>3. 0.25% of salt-tolerant Hydrocarbon Soil and Sludge Aqueous-Phase Washing Agent DC221 (by weight of original sample) was dissolved in 400ml of 4% salt solution and added to the liquefied sample, then agitated for 30 seconds. The sand precipitated rapidly.</p>
 <p>4. The surfactant/crude solution was decanted off to another container. The separation of crude oil (floating) 5 minutes after decanting is shown above.</p>	 <p>5. The remaining sand was agitated with a 4% brine solution for 30 seconds to wash it a second time.</p>	 <p>6. The washed and rinsed sand after drying.</p>

Conclusion

The weathered crude oil from the sample (ex Kuwait) was successfully recovered using a small amount of formulated surfactants (1% to 2% by weight of weathered crude oil/sand to be treated) with cold, salt water.

The above demonstrates a cost effective and environmentally sound process to recover the spilt crude oil from sand using a minimum of chemicals and

energy, and cold sea water to make up the process solution.

For a maximum recovery of crude oil, a two stage washing process is recommended. Washing plants may be designed to treat from 5 tonnes/hour to several hundreds of tonnes/hour using very high shear mixers and oil separators.